Trakia Journal of Sciences, Vol. 12, Suppl. 1, pp 325-327, 2014

Available online at:
http://www.uni-sz.bg

ISSN 1313-7050 (print)
ISSN 1313-3551 (online)

OCCUPATIONAL LEAD EXPOSURE. PREVALENCE

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ABSTRACT

Lead has been proved to have an effect on haemoglobin synthesis; smooth muscles; nervous system; metabolic diseases; diseases of the cardiovascular system (CVS) and the locomotor system (LS). The mechanisms of the last three impacts have not been completely clarified.

The **aim** of the present study was to register the prevalence in people engaged in lead acid battery manufacturing, as well as the effect of their occupational contact with the metal on the frequency of occurrence of CVS and LS diseases (diagnoses specified according to ICD-10).

Contingent and methods. The study involved 197 men directly engaged in lead acid battery manufacturing. The contingent studied was distributed according to the units and professions, as well as in groups according to age and duration of work in contact with lead. The results were statistically processed by means of parametric and non-parametric methods (Chi-Square Test), at a significance level $p < 0.05$.

Results. The average age of the people studied was 44.6650±9.61713. Out of all the workers examined, 49.8% (117 men) were clinically healthy; 26.8% (63 men) suffered from diseases of the cardiovascular system, with registered arterial hypertension (AH) in 57 men. Only age significantly influenced AH frequency in the people studied. The data obtained for AH frequency in smokers and non-smokers are of interest. The frequency of LS diseases was 11.7% (23 men). Blood lead content in the workers with LS diseases was reliably higher (p=0,030) than in those not suffering from these diseases. The analysis of the results obtained showed that blood lead content in smokers was reliably higher than in non-smokers (p=0.005). In the smokers group, no significant difference was found in blood lead content between people suffering and not suffering from LS diseases. In the non-smokers group, however, blood lead content in workers with LS diseases was reliably higher than in those not suffering from these diseases (p= 0.002).

Conclusion. The analysis of the results from the present study gives us grounds to hypothesize that workers with high blood lead levels and registered chronic diseases stop smoking.

Key words: occupational exposure, lead acid battery manufacturing, blood lead level, biological monitoring, prevalence, smoking, gout, arterial hypertension.

In spite of the advance in the technologies applied in lead acid battery manufacturing, the risk of lead impact still remains a significant health issue. Because of the proved noxa bioaccumulation, lead brings about damage to health - to a large number of body organs and systems at relatively low levels in the air of the working environment, i.e. at values close to the threshold limit value.

Lead has been proved to affect first of all haemoglobin synthesis and erythropoiesis; smooth muscles; the peripheral and central nervous system; metabolic disorders such as gout; diseases of the cardiovascular (CVS) and musculoskeletal (MSS) system. The mechanisms of the last three impacts have not been fully elucidated yet.

The **aim** of the present study was to register the prevalence in people engaged in lead acid battery manufacturing, as well as the effect of their occupational contact with lead on the frequency of occurrence of CVS and MSS diseases (diagnoses specified according to ICD-10).

Contingent and methods. The study was an exhaustive epidemiologic investigation involving 197 men directly engaged in lead acid battery manufacturing, who were from 22 through 65 years old.

The following features with risk implications were used in the study: **Factor characteristics (independent variables):** age, gender, total working experience, working experience in lead acid battery manufacturing, harmful habits (smoking). **Resultant variables (dependent variables):** morbidity and clinical status, functional performance. **Type of study**: transversal, descriptive and analytical.

Questionnaire methods, as well as instrumental, clinical, toxico-chemical and statistical methods were used in the study.

The selection of narrow specialists (an internist, a cardiologist and a neurologist) and the set of instrumental methods (blood pressure and recording an ECG at rest) and toxico-chemical tests (blood lead content) were in compliance with the requirements of the Regulations in force on the Safety and Health at Work and on the Factors of Working Environment. The diagnoses were specified according to ICD-10.

The **statistical processing** of the results involved parametric and non-parametric methods (Chi-Square Test) at a significance level $p < 0.05$.

RESULTS OF OUR OWN STUDIES

The average age of the people studied was 44.66±9.62. According to their age, they were divided into two groups, the first one consisting of those under 40 years of age (32% of all people studied), and the second one including the workers over 40 (68% of the people studied).

Their working experience in lead acid battery production ranged from several months to 28 years, with a mean value of 5.48 ± 7.03 years, which was related to the distribution in groups as follows: 40.6% of the workers had a one-year working experience in battery production; 23% had from 2 to 5 years of working experience, 13.4% had from 6 to 10 years of experience; 16.0% had from 11 to 20 years of experience, and 7% of all people studied had a working experience of over 20 years.

Clinically healthy were 117 of all workers investigated. Sixty-three of them suffered from diseases of the cardiovascular system, arterial hypertension (AH) being registered in 57 of them. Twenty-six workers suffered from diseases of the musculoskeletal system, 4 of which were diagnosed with gout.

The people working in the different units of the Battery Manufacturing Plant were distributed in the following way: 26% of all people studied worked in the Pasting Unit; 21% worked in the Formation Unit, 26% in the Assembly Unit, and 17% worked in the Foundry Unit. The remaining 10% of the people studied worked either in auxiliary units, or in the administrative unit of the plant.

In all four units the number of clinically healthy people predominated (from 51.0% to 72.7%). The frequency of the diseases involving people working in the different units of the plant varied from 3.0% to 33.3%. The AH frequency was highest in the Assembly Unit – significantly higher, as compared to the remaining units.

Age had a reliable influence on the frequency of occurrence of CVS diseases and AH in the people studied ($p<0.001$). The frequency distribution of AH in the groups formed according to age showed a significant (statistically reliable) difference in the men aged under 40, as compared to those aged over 40. The same dependence was found in analyzing the occurrence of MSS diseases in the workers studied.

The data regarding AH frequency in smokers and non-smokers were of considerable interest. The relative portion of people with registered arterial hypertension proved to be over two times larger in non-smokers than in smokers, the difference being statistically reliable **(Table 1).** Similar results were observed regarding the frequency of MSS diseases. In the non-smokers group their relative portion was also reliably higher than in the smokers group.

Discussion. Lead blocks predominantly the thiol enzymes in the body, affecting in this way the functions of almost every organ. That is why it is referred to as “a systemic protoplasmic poison”. The clinical manifestations of lead toxicity include symptoms involving the central and peripheral nervous system, the haematopoiesis, the kidneys and the gastrointestinal tract. Even at low exposure levels, the occupational contact with lead is considered to result in alterations in arterial blood pressure, as well as in AH occurrence and development (Staessen JA. et al., 1995, 1996).

Table 1. *Distribution of Diseases According to Harmful Habits*

Indicator	„Yes"		„No"	
	number	%	number	%
Smoking (questionnaire data)	111		73	
AH	23	20.7	33	45.2
MSS diseases	12	10.8	12	16.4

In a meta-analysis of 23 studies involving 33 141 people, 10 of which focused on people contacting lead in their working environment, the authors proved the existence of such a correlation (Staessen JA. et al., 1994). Martin D. et al. (2006), Nash D. et al., (2003), Glenn BS. et al. (2006) and Glenn BS. et al. (2003) reported that blood lead levels and bone lead levels were related to the blood pressure values in older individuals and occupationally exposed groups of the population. The results of the present study were consistent with these data.

We compared the blood lead content of the workers studied and found that in people with MSS diseases it was significantly higher (p=0,030) than in those with no diseases. Apart from that, the analysis of the results showed that blood lead content in smokers was reliably higher than in non-smokers (p=0,005). In the smokers group, no significant difference was found in the blood lead content of people suffering and not suffering from MSS diseases. In the non-smokers group, however, the blood lead content of the workers with MSS diseases was reliably higher than in those having no diseases (p=0,002). The retrospective study that was additionally conducted revealed that the majority of the workers that denied smoking in their answers to the questionnaire, were in fact former smokers. The individuals with the highest values of blood lead level were taken out of the working environment, and a reduction in their blood lead level was found after a 3-month period of non-exposure to lead. Rejection of harmful habits and taking measures for exposure reduction should, in our opinion, be included in the programme for reduction of health hazards. Their effectiveness remains to be checked.

CONCLUSION

The analysis of the results of the present study gives us grounds to hypothesize that workers with high blood lead levels and registered chronic diseases choose to stop smoking, which combined with the interruption of the contact with lead, are the measures that have to be taken, with view to preventing health deterioration and maintaining working capacity.

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